Returns to National Honey Board Marketing Programs: 2018 - 2022

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Honey demand in the U.S. has been remarkably strong over the 2018 - 2022 study period. Although retail prices have risen substantially over the past five years, there is no evidence of a substantial decline in the volume of honey purchased, either through the retail (table) channel, or for manufacturing purposes. In this context, we seek to evaluate the role of National Honey Board (NHB) marketing activities in increasing the demand for honey, and thereby generating higher returns to honey producers and importers. In this report, we summarize our findings from an econometric analysis of NHB marketing activities.

Executive Summary

- The objective of this study is to determine the return on investment to producer and importer funds invested in National Honey Board marketing activities. We examine two markets in which honey produced in the U.S., or imported by firms to the U.S. are typically sold: The retail market, consisting of sales through supermarkets, club stores and other outlets, for table use and the manufacturing market, which consists of producers of breakfast cereals, snacks, beverages, or any other food or beverage that uses real honey as a sweetener. Honey is sold into both markets in many different forms and colors, and in many different package-variants (Bee Culture 2023). In this study, we are concerned with how NHB activities influence the demand, and the profitability, of selling any type of honey into either the retail or manufacturing-ingredient markets.
- Returns to NHB marketing activities are calculated using an equilibrium model of honey supply and demand. That is, marketing activities are assumed to affect the annual demand-flow for honey in each end-market. Given the existing supply of honey, therefore, the market price will adjust to clear the market, or equate supply and demand. The resulting price impact is used to calculate the marginal impact on producer or importer profit, and hence the return to the amount of funds invested. We develop two equilibrium models that follow this same logic, one for the retail market and another for manufacturing sales.
- All models are estimated with data made avail-

able from the NHB, the Economic Research Service of the USDA (ERS-USDA), and other public sources. We infer the amount of honey that moves into the retail channel by subtracting the amount used for manufacturing from the total annual honey supply as reported by ERS-USDA.[1] All marketing investment values are derived from NHB financial records, and are aggregated into a single category of expenditure, on an annual basis. Investments in honey market development are assumed to influence both retail and manufacturing demand, and affect equilibrium market prices.

- For both the retail and manufacturing models, we estimate short- and long-run elasticity values for four different demand drivers: (1) price, (2) demographics, (3) competing product prices, and (4) marketing investments. Elasticity is defined as the ratio of the percentage change in demand to the percentage change in the variable of interest. Elasticities are important as they are unit-free measures of the responsiveness of demand to each variable. We refer to "price elasticities" when referring to how consumers respond to changes in price, and "marketing elasticities" when referring to the responsiveness of honey demand to NHB marketing investments.

- We first estimate the price elasticity of demand. In this regard, honey is very inelastic in demand, which means that overall honey demand is not sensitive to changes in price. The short-run retail price elasticity of demand is -0.28, on average, aggregating over all types of honey, while the long-run retail price elasticity is -0.35. In other words, if the retail price rises by 10 percent, demand is expected to fall by 2.8 percent in the short run, and 3.5 percent in the long run. All price-elasticity estimates are statistically significant, and the models fit the data very well (R-squared is greater than 95.0%.

- We next estimate marketing elasticities. The short-run marketing elasticity, or the percentage change in demand for a given percentage change in marketing dollars, is 0.059, while it is 0.074 in the long run. Both of these estimates are high relative to marketing elasticities for other commodities.

[1]All of our data-gathering procedures are consistent with those used in previous studies (Ward 2013, 2018) for purposes of comparability. As we explain below, however, our econometric modeling procedures differ in important ways.

- Return on investment is measured using two, equivalent metrics: (1) the benefit:cost ratio (BCR), and (2) return on investment (ROI). BCR is calculated as the present value of producer or importer profit divided by the amount of investment, while ROI is the same calculation expressed as a percentage of the initial investment. In this summary, we report both BCR and ROI values, but they are equivalent measures of investment return. For purposes of this report, we calculate both the revenue BCR (R-BCR) in order to provide comparable measures to past reports, and the profit BCR (P-BCR) which is a more economically-relevant measure of incremental profit due to marketing investment. R-BCR is the ratio of incremental revenue to another dollar of marketing investment, while P-BCR is the incremental profit to another marketing dollar.

- Retail Model Results: We calculate R-BCR and P-BCR values for aggregated marketing investments in the retail market. In total, we find that the estimated short-run R-BCR is 38.89 (38.89 dollars in revenue for the next 1.00 dollar invested) and 48.59 in the long run. These R-BCR values imply ROIs of 3,789% in the short run and 4,759% in the long run. On the other hand, the P-BCR values are 1.98 in the short run, and 2.31 in the long run, which imply 1.98 dollars of profit for the next dollar invested in the short run, and 2.31 dollars in the long run, respectively. The implied ROI values are 98.0% in the short run, and 131.0% in the long run. In the retail market, NHB investments appear to be highly profitable, both in the short and long runs relative to any reasonable rate-of-return benchmark.

- The volume of honey in the manufacturing channel was calculated from USDA-ERS Sweetener Report data. Manufacturing demand is a "derived demand," meaning that honey is demanded as an ingredient in making end-products such as pastries, cereals, beer, and sweetened beverages for which there are several substitute ingredients. As an ingredient, the manufacturing demand for honey is also highly inelastic as the average price elasticity of demand in the manufacturing market was -0.10 in the short run and -0.11 in the long run. All estimated parameters were highly statistically significant. The elasticity with respect to marketing investments is 0.09 in the short run and 0.10 in the long run. Our estimates show some persistence in the effect of marketing investments in the manufacturing market, which explains the difference between the short- and long-run estimates.

- Manufacturing Model Results: Our econometric model provides estimates of the R-BCR and P-BCR for the manufacturing market. Again aggregating over all types of marketing investments, the short-run R-BCR in the manufacturing market is 165.71 and the long-run R-BCR measure is 179.01. In terms of P-BCRs, the short-run estimate is 8.73 (ROI = 773.0%) while the long-run estimate is 9.34 (ROI = 834.0%). In both the short- and long-runs, therefore, all marketing activities have BCRs greater than 1.0, and are highly profitable as they provide returns greater than NHB members' likely opportunity cost of capital (approximately 5.0 percent).

Introduction

In 2018, the beginning of our study period, US consumers purchased some 1.3 lbs per capita of honey, but per capita consumption rose to over 1.5 lbs per capita by 2022 (USDA-ERS 2023). At the same time, producer prices rose some 34%, from $2.21 per lb to $2.96 per lb. Figure 1 shows the change in demand over our entire data period (1987 - 2022) and the associated change in prices. With stagnant income growth over latter years of this figure – the years that frame our analysis – and an increasingly competitive array of sweeteners available to consumers, any growth in demand would suggest that retail prices had fallen, but the opposite was true. Rising demand amid with rising prices suggests that other factors must have been at work. Although summary evidence is not conclusive, from a high-level view, it appears as though NHB marketing activities have been effective in increasing demand.

Because many factors cause honey demand to change over time, we need to use econometric analysis to disentangle the true effect of NHB marketing on honey demand and prices. Isolating this effect allows us to estimate where honey demand would be in the US in the absence of any NHB marketing activities. Because the food market is a crowded place, and growing demand is difficult, we need to control for all possible factors that may have influenced honey consumption and prices in order to sort out the unique effect of the NHB's work. The difference between what we observe in sales reports and "what might have been" constitutes a return on investment. In this study, we quantify that return and determine what works for marketing honey in the long and short run using econometric models of honey demand, both on the table and as a food-ingredient.

What is an econometric model, and why are they useful? Econometric models are statistical methods that are able to identify the true causes of observed changes in demand when many things are changing at the same time: Prices, incomes, tastes, demographics and, most important for the purposes of this study, marketing investment. Econometric models answer the question: "if everything else is held constant, what is the independent effect of changes in advertising or promotion?" For immediate purposes, econometric models are useful because the 2002 Farm Security and Rural Investment Act (FSRIA) requires econometric analyses of federally-sanctioned marketing organizations every five years. More fundamentally, however, investment and allocation decisions are better informed when the stakeholders know what works and what does not, or what deserves more investment and what less. The models used here are designed with this purpose in mind.

We also recognize that many investments made by the NHB are long term in nature. Whether it is building connections between consumers and producers and importers through social media, spreading the word about new menu items, or even building a strong web-presence, marketing investments are intended to "build the brand" as a long-term proposition. In this study, we estimate both the short- and long-term effects of NHB activities on demand, and define member returns to include both immediate impacts and those that may not be felt until several months or years in the future.

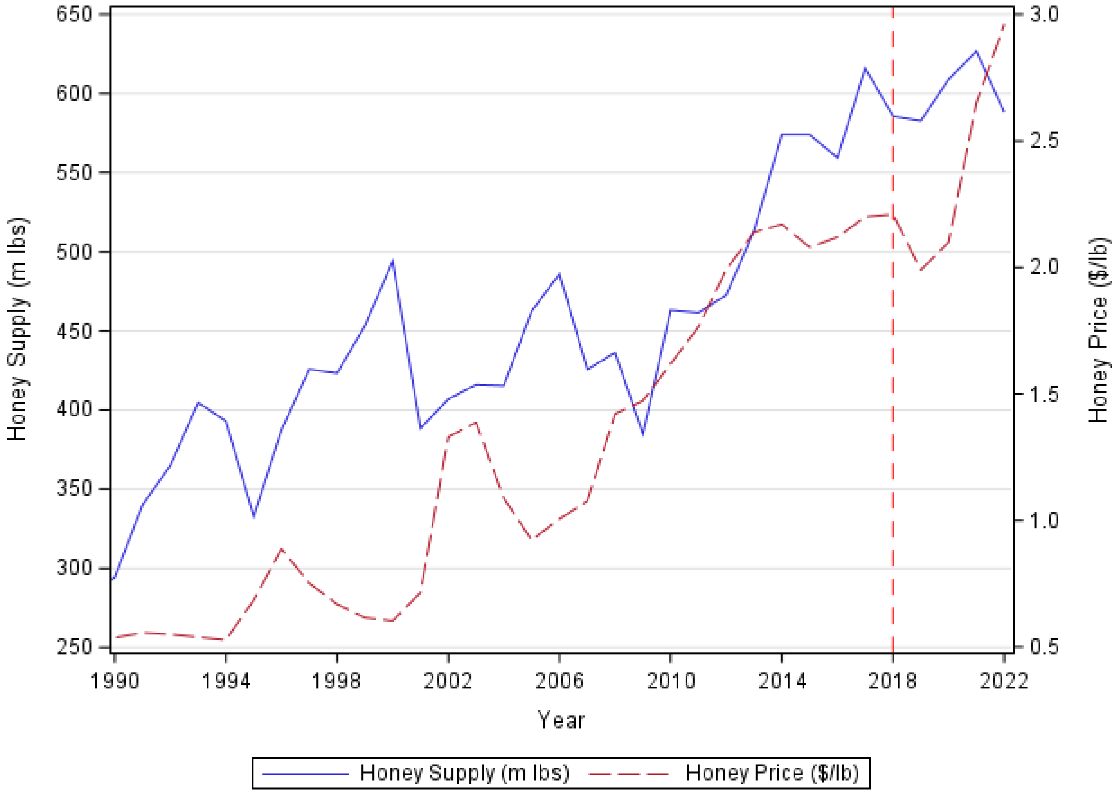
Objectives

The primary objective of this research is to estimate the long-run return on NHB stakeholders' marketing investments during the period 2018 - 2022. To this end, our research encompasses a number of intermediate objectives. They are:

- To estimate the long-run impact of NHB marketing activities on the retail and manufacturing demand for all types of honey (varieties and packages) using a variety of econometric modeling techniques applied to USDA supply, import, stock and export data.

- To determine the long-run price impact of NHB

Figure 1. Total Honey Supply and Prices, by Year



marketing activities by developing models of each supply chain.

- To use the estimated demand effects at the producer and importer level to calculate an expected annual increment to stakeholder revenue and profit, the net present value of all future revenue and profit (net of program costs) and, ultimately, the return on investment (defined as the benefit:cost ratio, or R-BCR and P-BCR for revenue and profit measures, respectively) due specifically to NHB marketing activities.

Data Sources and Summary

Accurate and timely data are essential to achieving our objectives, both for honey moving into the retail and the manufacturing channels. In this respect, we have access to ERS-USDA data from the annual Sugar and Sweeteners Yearbook Tables, from which we calculate the amount of honey that moved through the retail channel over a long historical period (1987 - 2022), which is ideal for econometric purposes. Although we do not have data specifically on retail demand, we infer an aggregate amount of retail honey usage by subtracting manufacturing demand, which is reported in the ERS-USDA data, from total annual honey supply. We supplement the USDA data with data from the St. Louis Federal Reserve on consumer incomes, population, and general price levels over the same sample period. Controlling for these other factors that may influence demand is important in order to isolate the effect of NHB investments on retail demand.

Data on manufacturing demand are also from the ERS-USDA Sugar and Sweeteners report. Unlike the retail data, the ERS-USDA data set reports the amount of ingredient movement into different industries, which we aggregate to form a total measure of annual manufacturing demand. We combine this data, also over the 1987 - 2022 estimation period, with data on confectionery prices (to capture the value of end-product made with honey) as well as prices for substitute sweeteners (beet and cane sugar).

Our measures of marketing intensity are drawn from NHB financial records, on an annual basis, and represent the amount actually spent each year, as opposed to the amount budgeted. Expenditures are only available at an aggregate level, so we are unable to estimate the impact, and ROI, for different types of media or category of marketing activity. In the future, if analyses are to be useful in helping managers allocate expenditures among different categories of marketing investment, we recommend closely tracking either spending in each area, or marketing impressions.

As a technical matter, weekly prices in both the retail and foodservice models are endogenous, meaning that they are determined at the same time as demand quantities. In other words, when prices and quantities change at the same time, it is impossible to disentangle the effect of marketing activities on demand without some way to independently control for price variation. For this purpose, we use input prices as instruments for the retail price. Specifically, we use prices on range of honey inputs, including insecticide prices, fuel, labor, business services, and sugar in order to instrument for retail prices. All of these prices are taken from public data sources, including USDA-NASS and the Bureau of Labor Statistics.

We summarize all of our estimation data in Table 1, scaled for presentation purposes. Most importantly, the data in this table shows that there is sufficient variation in the key variables in our analysis – prices, volume movement and marketing investments – to identify the parameters we use to calculate the returns to honey marketing.

There are other observations from the data that deserve mention, and are directly relevant to our objectives. First, honey for manufacturing purposes is growing in importance. This dynamic is particularly striking in the period following the COVID-19 pandemic of 2020 and early 2021. In fact, prior to the pandemic, manufacturing uses accounted for some 71.5% of all honey consumed in the US, while by 2022 the share used in manufacturing had grown to over 82.3% of all honey (figure 2). As we show in more detail below, returns to marketing activities in the manufacturing market reflect this fundamental rise in demand as marketing in the ingredient market is many times more profitable than in the retail market.

Second, imports are growing as a share of total availability over time (figure 3). Imports were only 67.7% of the total supply of U.S. honey in 2019, but the import-share grew to 76.8% by the end of our data period. Whether the rising share of imports reflects the rise in manufacturing demand noted above, or perhaps drives the increased use of honey as a food ingredient is a question that goes beyond our objectives here. But, given the importance of both manufacturing honey and imports in the total market for U.S. honey, it should likely be answered at some point in the future.

Finally, we note the increasing share of NHB assessments that are allocated to marketing and promotion, as opposed to administration and other organizational expenses. The data in table 4 show that the share of assessments used to market honey rose from about 66.0% in 2018 to over 71.0% in 2022, which was the final year of our analysis. This is both a favorable trend, and among the highest ratio of any board that we have studied in the last 20 years. In fact, relative to the performance we document below, this figure tells a very favorable story of NHB management.

All data analysis methods are well understood and accepted in the marketing-evaluation field and have been used extensively by the researchers. In the next section, we describe the specific research methods used in each model and explain the economic logic behind our approach.

Demand Models

Overview

Marketing activities benefit producers and importers by increasing demand, thereby raising surplus, or profit, on all honey sold, regardless of channel. Therefore, modeling demand is at the core of any econometric analysis of the returns to commodity marketing. In this section, we describe in detail two demand models estimated in order to achieve the goals described above: (1) an aggregate (over varieties and packages) retail demand model, and (2) a manufacturing demand model. In the following section, we describe how elasticity estimates from these demand models are used to calculate incremental profit, and return on investment.

Retail Demand for Honey

The first model estimates the demand for retail, or table, honey aggregated over all forms in which honey is sold at retail, on an annual basis, from 2018 through 2022. In this model, the volume of honey sold depends on its own price (deflated by a general consumer price index, or CPI, measure), the price of other sweeteners, seasonality, time-trends, past honey demand (as a measure of consumer habit and repeat-purchase behavior), consumer income, and the aggregated measure of marketing activity described above. Marketing activity is measured by dollar investments reported by NHB marketing staff.[2] The specific form of the model (a logit mar-

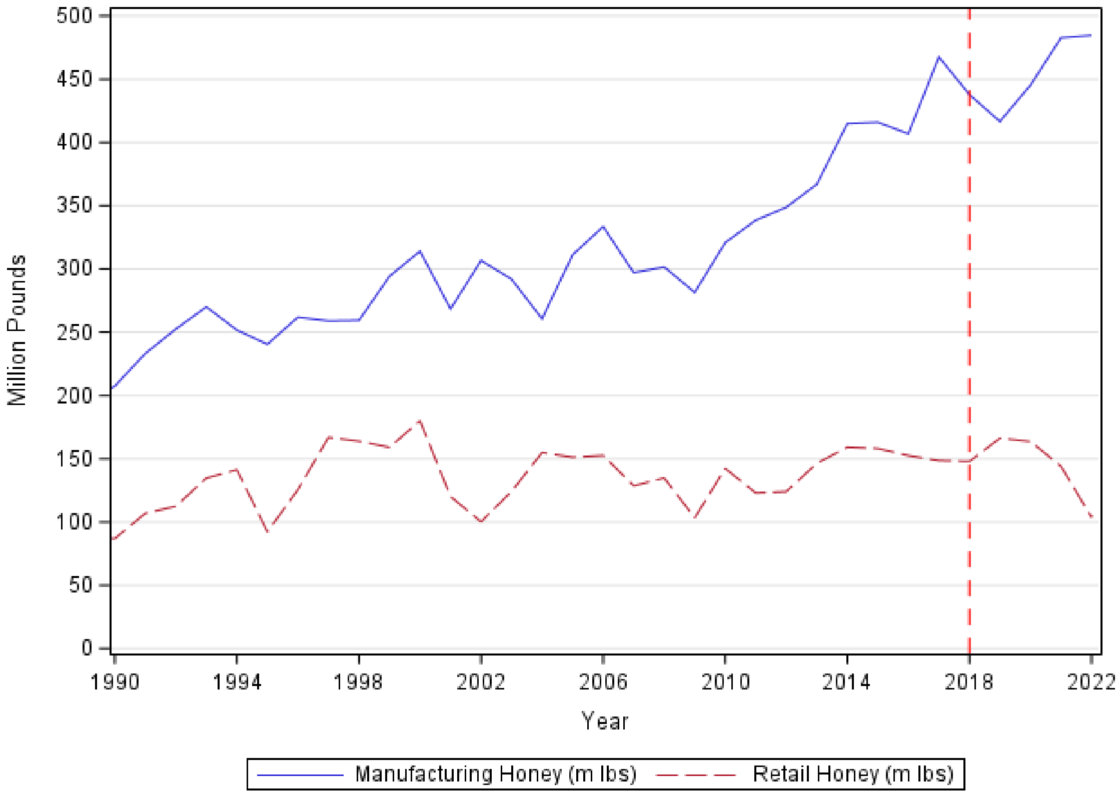
[2] Marketing activity can also be measured by the number of impressions through each media type. Measuring activity

Table 1: *Data Summary, Sources, and Units of Measure*

Variable	Source	Units	Mean	Std. Dev.	Minimum	Maximum
Sales	USDA-ERS	$ million	214.68	92.38	89.96	386.93
Production	USDA-ERS	million lbs.	179.57	31.41	125.33	235.44
Imports	USDA-ERS	million lbs.	235.96	126.70	55.90	485.67
Exports	USDA-ERS	million lbs.	9.95	1.77	6.87	14.00
Stocks	USDA-ERS	million lbs.	45.97	15.84	23.31	85.24
Manufacturing	USDA-ERS	million lbs.	318.33	83.22	193.45	484.57
Total Volume	USDA-ERS	million lbs.	451.56	98.70	281.15	626.75
Producer Price	USDA-ERS	$ / lb.	1.30	0.73	0.50	2.96
NHB Investment	NHB	$ million	1.39	1.93	0.00	5.40
Income	St. Louis Fed	$ / year	116.60	53.87	41.66	223.60
Population	St. Louis Fed	millions	292.68	28.83	242.84	333.60
Inflation	St. Louis Fed	% / year	2.75	1.50	0.14	6.82
CPI	St. Louis Fed	Index	175.26	42.44	104.35	264.99
PPI Chemicals	USDA-NASS	Index	86.06	17.61	56.40	120.50
PPI Labor	USDA-NASS	Index	87.93	29.86	50.00	156.90
PPI Supplies	USDA-NASS	Index	86.05	21.73	58.00	139.10
PPI Fuel	USDA-NASS	Index	53.71	27.54	24.60	111.30
PI Sugar	USDA-NASS	Index	32.42	6.26	25.60	50.00
PPI Confectionary	US-BLS	Index	158.17	39.88	104.69	236.01
PPI Beets	US-BLS	Index	131.25	25.48	94.40	193.40
PPI Cane Sugar	US-BLS	Index	131.70	27.36	97.20	198.35

Note: All data are annual, over the 1987 - 2022 sample period. For estimation, all variables are in natural logs.

Figure 2. Allocation of Honey Supply to Manufacturing and Retail Markets, by Year



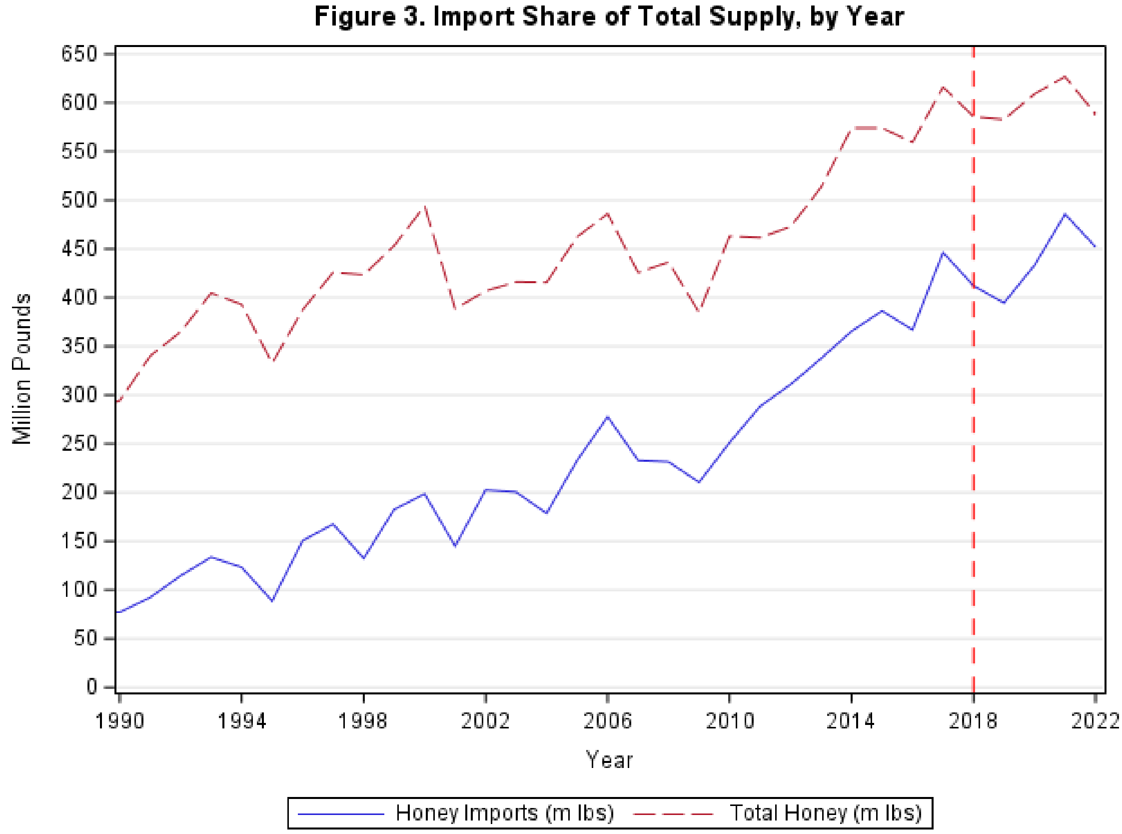


Figure 3. Import Share of Total Supply, by Year
Million Pounds
650
600
550
500
450
400
350
300
250
200
150
100
50
0
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year
Honey Imports (m lbs)
Total Honey (m lbs)

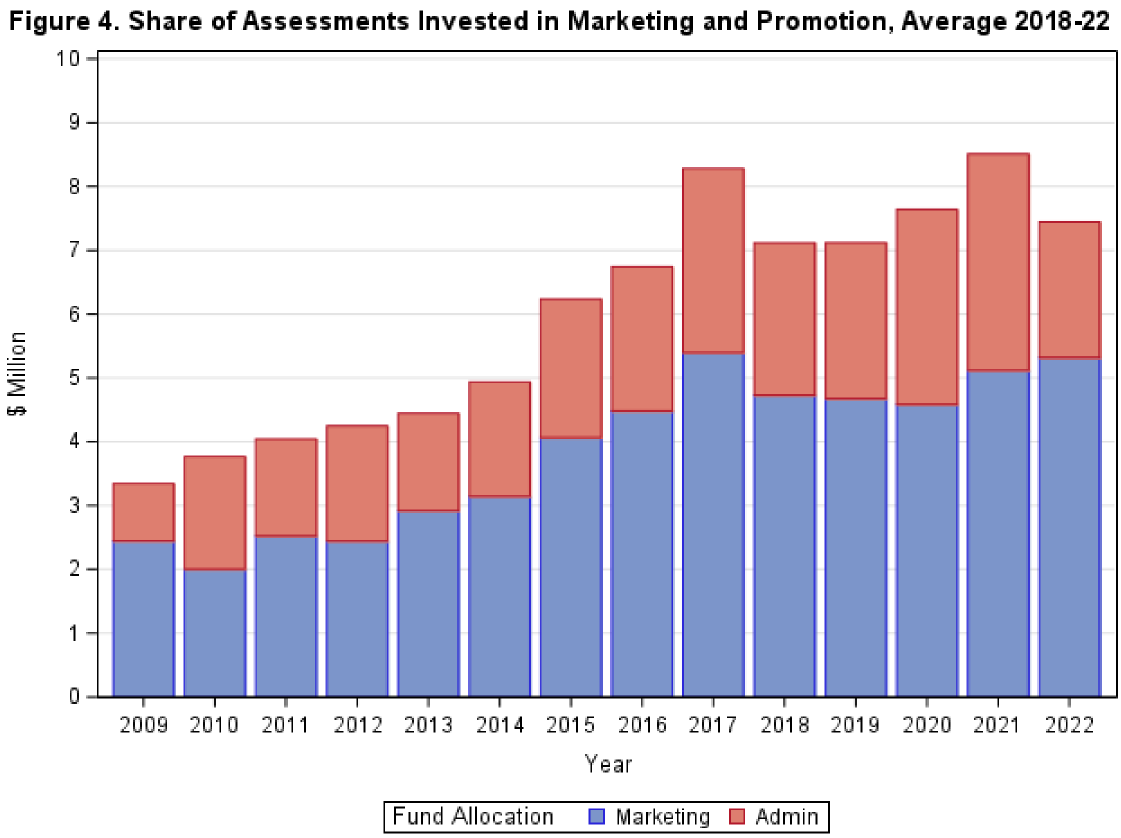


Figure 4. Share of Assessments Invested in Marketing and Promotion, Average 2018-22
$ Million
10
9
8
7
6
5
4
3
2
1
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Fund Allocation
Marketing
Admin

ket share model) is well-accepted in the quantitative marketing literature, and regarded as a standard for demand analysis. The specific form of the demand model is written as follows, and we provide further derivation in Appendix 1:

$$ln(s^r) - ln(s_0^r) = \beta_0^r + \sum_k \beta_{1k}^r x_k^r + \beta_A^r ln(A^r) - \alpha ln(p^r) + \epsilon^r,$$

where $ln(s^r)$ is the natural log of the market share of table honey in the market for all retail sweeteners, $ln(s_0^r)$ is the natural log of the market share of all other sweeteners, x_k^r is the vector of explanatory variables, consisting of the lagged volume of retail honey from the previous year, the log of per capita income in the U.S., a trend variable, and a control function (used to control for the endogeneity of prices), $ln(p^r)$ is the natural log of retail prices, and $ln(A^r)$ is the natural log of the amount of NHB marketing activities each year. In this expression, β_A captures the marginal effect, or the elasticity, of advertising on retail market demand.

Our choice of these variables is guided by best-practices from the promotion-evaluation literature. As such, there are a number of fundamental principles that are captured by the econometric specification. First, advertising of any type is expected to have a long-lasting effect on demand. Therefore, we differentiate between the short-run and long-run effects of both price and advertising as investments in "brand equity" are assumed to accumulate slowly over time. Second, advertising is subject to the principle of "diminishing marginal returns." That is, the more advertising in a particular market, the lower is the incremental gain from an additional dollar spent in that market so we assume marketing activities have a non-linear effect on demand. Third, we assume the impact of marketing expenditures varies over time so we allow for random marginal effects on consumer demand by year.

Marketing programs are investments, and not expenditures, so are expected to have lasting effects on consumers' perception of the product, and their likelihood of purchase. Whether this is through brand loyalty for a consumer good, "goodwill" toward a commodity, or simply by contributing to consumers' stock of knowledge regarding the nutritional and taste attributes of a product, the effect of marketing activities both builds over time with additional expenditure, and decays as older campaigns are forgotten or abandoned. Being able to model the lagged-effects of advertising carefully is important as these competing effects likely differ in strength as time passes. For example, publishing the effects of new nutritional research results may result in an increase in demand only after a considerable amount of time has passed before consumers learn or truly understand the effect, while older research results may be forgotten or superseded by new results. To capture the complexity of the dynamics involved in this process, we model each measure of marketing intensity using a geometric lag model. Simply put, a geometric-lag process is a flexible and parsimonious way to capture both long-term and short-term advertising impacts in an econometric model. We develop the geometric lag model more formally in the appendix.

Measures of the stock of advertising capital, or A_{ij} in the econometric model, typically comprise expenditure values for each type of marketing expenditure (i.e., online, TV, social media, etc.). In this case, however, we did not have data on different types of expenditure, over time, so consider only one aggregated measure of spending. Disaggregating media types is convenient because the estimated parameter provides a direct measure of the marginal or incremental effect of one more dollar of expenditure. We then measure the effectiveness of marketing expenditures by calculating the marginal effect on sales volume per dollar spent through the "advertising elasticity" metric. In this way, our method produces a direct measure of how the incremental, or "last dollar," of marketing expenditure influenced demand.

Income is also likely to have a significant effect on demand. The combined retail data set includes an annual measure of real income earned by U.S. consumers, so we included the log of real income in the demand model. Assuming honey is a "normal" good in the economics sense, we believe retail demand should rise in the level of income. Therefore, we expect to find a positive relationship between this variable, and annual volume movement.

Casual inspection of retail honey sales data shows that sales vary by year for reasons that may not be due to price, income, or the prices of competing products. Therefore, we capture year to year variation in demand by including annual "fixed effects" which absorb all variation in year-to-year demand that is not otherwise captured by the variables we include in the model.

this way is useful as it is able to attach an economic value to each incremental impression.

Manufacturing Demand

Our second model of demand focuses on the manufacturing market, or the demand for honey as a sweetening ingredient in bakery, cereals, beverages and other foods. In general, data for foods used in manufacturing processes tends to be hard to come by as food processors are private firms that generally do not share data. However, the ERS-USDA Sugar and Sweeteners Report captures the amount of honey that flows into the industrial channel as part of their more general attempt to explain flows of sweeteners more generally. Because of the historical prominence of sugar in U.S. agricultural policy, the USDA has a keen interest in understanding the drivers of not only sugar demand, but products that substitute for sugar in all of its uses. Therefore, we are confident that our manufacturing-honey data accurately reflects industrial demand for honey as a sweetener-ingredient.

Manufacturing purchases are what is known as a derived demand, as we explained above. Derived demand means that honey is not purchased by the ultimate consumer, but by the manufacturer, processor, or other organization that uses honey to produce another food or beverage that is sold to consumers. In this regard, the relevant price paid is not necessarily a retail prices, but a wholesale price paid by intermediary purchasers. We use the ERS-USDA price for this purpose because it reflects the first-handler price, or the price that is closest to what manufacturers likely pay. We recognize, however, that the industrial market is very diverse, and firms purchase ingredient honey for a wide variety of purposes. Even if we do not have the specific price paid for each end-use, the ERS-USDA price is likely to be highly correlated with prices paid by individual firms, so is valid for econometric purposes.

In addition to the annual price of ingredient honey, the manufacturing demand model includes yearly indicator variables, prices for ingredients that likely substitute for honey (cane and beet sugar, and high-fructose corn syrup), a price index for one of the many products made with sugar (confectioneries), and marketing investments. We account for the long-run effect of marketing investments in a method similar to that described above, that is, we allow for honey demand to follow a geometric lag process. Essentially, a geometric lag simply means that the impression has its largest effect in the first year, and then declines geometrically for every year after that. In terms of the econometric model, a geometric lag is specified simply by including a one-period lagged value of the dependent variable (lagged quantity). We also account for the diminishing marginal returns to marketing investments by taking the log of total marketing expenditures each year. We again use an aggregated measure of investments made in all budget categories.

Algebraically, the manufacturing and retail models are relatively simple. In each, we regress the log of manufacturing market share on the logs of all the explanatory variables described above. This logit demand model has the advantage that each of the estimated parameters is the relevant elasticity measure. Elasticities of demand, in addition to the elasticities of supply and price transmission, are all that is needed to calculate the returns to honey marketing. We write the manufacturing demand model as follows:

$$\ln(s^m) - \ln(s_0^m) = \beta_0^m + \sum_k \beta_{1k}^m x_k^m + \beta_A^m ln(A^m) - \alpha ln(p^m) + \epsilon^m.$$

where $ln(s^m)$ is the natural log of the market share of honey in the market for manufacturing sweeteners, $ln(s_0^m$ is the natural log of the market share of all other sweeteners in the manufacturing market, x_k^m is the vector of explanatory variables, consisting of the lagged volume of manufacturing honey from the previous year, the log of confectionary prices (bakery items, an output that uses honey as a sweetener), bee prices, a trend variable, and a control function (used to control for the endogeneity of prices), $ln(p^m$ is the natural log of manufacturing-honey prices, and A^m is the natural log of the amount of NHB marketing activities each year. In this expression, $beta_A^m$ captures the marginal effect, or the elasticity, of advertising on manufacturing market demand.

As with the retail model above, we estimate the manufacturing demand model using instrumental variables methods to account for the fact that prices are likely to be endogenous, or determined simultaneously with the quantity demanded. Instruments for prices in both models are formed from a set of input prices (chemicals, energy, manufacturing labor, business services and packaging) as well as other variables that are determined outside of the demand model, such variations in the U.S. population, income and lagged consumption values. These instruments explain much of the variation in prices and are independent of the equation errors *a priori*.

Calculating Return

In the next stage of the analysis, we use the demand elasticities estimated above to calculate the return to marketing investment. We describe the returns-simulation process more formally in the appendix, but provide the intuition of how it works here. We use two, equivalent measures of return: (1) the benefit:cost ratio (BCR) and (2) the return on investment (ROI). BCR is calculated as the ratio of the present value of producer profit to the amount of investment. ROI is calculated as the ratio of the present value of the incremental gain in profit (producer surplus) generated by each program in the most recent fiscal year to the total amount of capital invested, or the cost of marketing activity. For purposes of this report, we calculate two variants of the BCR measure, one that defines "returns" as industry revenue, the R-BCR, and one that defines returns in terms of incremental producer profit, or the P-BCR. While we consider the latter to be more economically relevant, we report the former for comparison to previous evaluations.

Incremental profit is the present value of the difference between higher revenue generated from the increase in demand and higher production costs.[3] We express P-BCR on a per-dollar-of-investment basis as it communicates our expectations of how much profit each dollar of investment should generate. P-ROI is expressed on an annualized, rate of return basis in order to remain as comparable as possible to returns growers can expect on other investments, such as capital invested in their farms or in external capital markets.

Because we estimate both short- and long-run demand elasticities, we estimate both short- and long-run changes in profit. In the long-run calculation, however, we also allow for the fact that producers or importers are likely to increase the supply of honey in response to higher returns so we account for the "feedback effects" that we expect to result from a successful marketing program. Further, because the BCR / ROI estimate depends on the parameters of the producer surplus model (the elasticity of supply), we calculate BCR / ROI using a value for the supply elasticity taken from the literature on honey supply.

[3] In the simulation model described in Appendix 2, we capture the likely increase in production costs due to higher production volumes by allowing for a non-zero elasticity of product supply. In a competitive industry, the industry supply curve is the marginal cost curve so an upward slope captures higher marginal costs.

Results and Discussion

Demand Models

We estimate retail demand using the econometric model described above. Based on the estimates from this model, we then calculate response elasticities with respect to the retail price, and marketing activity, and summarize these elasticity estimates, both short-run and long-run, in table 2. All detailed parameter estimates, for both the Retail and Manufacturing demand models, are shown in Appendix 3. Most importantly, the short-run price elasticity is approximately -0.28, which is substantially smaller (closer to zero, or less negative) than previous studies (Ward 2013, 2018). Further, when we account for the dynamic nature of demand, the long-run elasticity is -0.35, which is again highly inelastic. Our elasticity estimate is relatively small because we account for both price endogeneity and unobserved heterogeneity (random parameters) whereas previous studies did not. Without removing the econometric bias that results from endogeneity and unobserved heterogeneity, estimates based on observed data are likely to be in error. A price elasticity of -0.35 means that if price were to rise by 10 percent, the retail quantity demanded would fall by 3.5%, all else equal.

Table 2: *Retail Demand Model Estimates*

	Short Run	Long Run
Price	-0.2822	-0.3526
Marketing	0.0591	0.0739

Note: Estimates produced by log-log instrumental variables regression. See appendix for details.

Our estimate of the elasticity with respect to marketing activities, or investments, is statistically significant, and positive, which means that marketing expenditures – independent of the other factors that affect demand – has a positive effect on demand. Specifically, the short-run elasticity estimate with respect to the aggregate measure of marketing activity is 0.0591, and the long-run elasticity estimate is 0.0739. These estimates mean that we expect a 10% increase in marketing to generate nearly a 0.6% increase in retail honey volume in the short run and a 0.07% increase in the long run. Although we cannot compare the relative effectiveness of different types of investment with our aggregate measure of investment, the fact that our elasticity estimates are positive and significant suggest that the NHB has a material impact on table honey demand. Moreover, because we control for diminishing marginal returns to program investment, the NHB is clearly not investing enough on marketing to drive the incremental return to the next dollar spent to zero.[4]

Like retail honey demand, the manufacturing demand for honey is also inelastic with respect to prices (table 3). The short run price elasticity of demand is -0.1014 and the long run price elasticity is -0.1096. In general, manufacturing demand is less elastic than retail demand because manufacturing entities tend to rely on fixed formulations that demand the use of certain ingredients. Moreover, honey is a relatively small part of their budgets, so small changes in honey prices are more easily overlooked. Moreover, finding a long-run elasticity that is substantially larger than the short run elasticity is due to the fact that the rate of adjustment over time is relatively small, which means that quantity demanded adjusts to its long run equilibrium value only slowly over time. For marketing purposes, however, it is the short run price elasticity that matters as markets are always in a state of fluctuation and price changes in one year are nearly always superseded by changes in the following year.

Table 3: *Manufacturing Demand Model Estimates*

	Short Run	Long Run
Price	-0.1014	-0.1096
Marketing	0.0893	0.0965

Note: Estimates produced by log-log instrumental variables regression. See appendix for details.

Again, because manufacturing demand is derived from what consumers are asking for in honey-sweetened end-products of all types, the variables that affect demand are those that mediate the demand for end-products through industrial purchasing managers. Based on the results shown in table 3, we find a short run elasticity of manufacturing demand with respect to aggregated marketing investments of 0.0893 and a long-run elasticity of 0.0965 (see table 3). These estimates are among the highest we have seen in all the commodity-board evaluations we have done, which speaks directly the apparent effectiveness of NHB marketing messages targeted to the manufacturing channel. Although these elasticities are of value independent of any other purpose, our primary interest in estimating them is to use them as inputs to the returns-calculation model.

[4] On this point, it is instructive to compare the current ratio of investment to honey sales to the so-called Dorfman-Steiner Rule, which maintains that the optimal advertising-to-sales (AS) ratio should equal the ratio of the advertising elasticity to the price elasticity of demand. In the current case, the optimal AS ratio (long run) is approximately 21%, which implies an optimal advertising budget (at the mean sales level in Table 1 of nearly $45.0 million. Currently, the NHB is investing about 10% of the optimal amount.

Returns to Marketing Investments

In this section, we present and explain the returns to marketing investment in both the retail and manufacturing channels. Further, due to the long-term nature of marketing investments, we calculate present value of incremental profit over the sample period for both the P-BCR and ROI measures. Taking into account the entire future stream of profit due to an investment in each period is important because any marketing investment is expected to have long-term demand effects. Our calculations provide estimates of the marginal return, as opposed to the average, as growers and shippers are interested in the return on the next dollar invested when making budget allocation decisions.

In this study, we calculate P-BCRs and ROIs for the aggregate measure of marketing activity in the retail market over a range of possible supply elasticities, from 0.25 to 1.5 with the most-likely value 1.0, and report the most-likely P-BCR values in table 4 below. The ROI values show a similar pattern, so are not included in the table. In general, returns fall as the elasticity of supply rises (price effects are muted with more elastic supply) and, given that empirical estimates of most commodity-supply elasticities are substantially lower than 1.0, our estimates are relatively conservative. After presenting and interpreting the P-BCR estimates we present and interpret estimates from the alternative R-BCR measures, for comparison to prior evaluations.

Table 4: *Retail & Manufacturing P-BCR Estimates*

	Short Run	Long Run
Retail	1.9785	2.3102
Manufacturing	8.7322	9.3409

Note: Estimates produced by log-log instrumental variables regression. See appendix for details.

From the results reported in table 4, we see that marketing activities in the retail market generate positive returns in the long-run as all P-BCR values are well above 1.0. A P-BCR greater than 1.0 means that an activity generates more dollars in incremental value (present value of future profit) than the investment cost. With respect to the specific estimates, the values in table 4 show that marketing investments targeted toward retail sales generate a BCR of 1.9785 (ROI = 97.9%) in the short-run, and 2.3102 (ROI = 131.0%) in the long-run. In other words, funds invested in retail-targeted activities generate 1.9785 dollars of incremental profit in the retail market for every dollar invested in the short-run, but 2.3102 dollars in the long-run.

Equivalently, the ROI estimates imply that the same investment would be viable with virtually any reasonable hurdle rate of return in either the short- or long-runs. To put this into perspective, if the cost of capital for a typical producer is in the range of 5.0 - 7.0 percent, a 97.9% ROI generates a very substantial surplus return. Because most producers are presumably invested for the long-run, for practical purposes the long-run estimate is more meaningful, and suggests that investments in retail marketing are highly profitable.

We note also that these estimates compare favorably with other evaluations we have done in the past (e.g., U.S. mushrooms, potatoes, etc.) and with previous analyses (Ward 2013, 2018, corrected to reflect profit instead of revenue) so again speak to the consistency of effort and effect from NHB activities.

In the manufacturing channel, marketing investments are expected to have an impact that is filtered through buying decisions made by processors and food and beverage manufacturers. The estimates in table 4 suggest that marketing investments have an expected P-BCR of 8.7322 (ROI = 773.2%) in the short-run and a BCR of 9.3409 in the long-run (ROI = 834.1%). Therefore, we can conclude that marketing activities generated by the NHB have substantial, positive returns in both the short- and long-runs. In fact, the returns in the manufacturing channel are among the highest we have ever seen. Again, if producers and importers are accurately assumed to be invested for the long-term, it is only the long-run return values that are of concern to NHB stakeholders.

We also estimate a measure of return that is comparable to the estimates provided in previous evaluations (Ward 2013, 2018).[5] While our P-BCRs are calculated using incremental profit to producers and importers, revenue-BCRs (R-BCRs) reflect the incremental revenue generated from the next dollar of marketing investments. These values are, by definition, substantially larger than the P-BCRs presented above as every pound of additional honey produced and sold does not necessarily generate pure profit to sellers so cannot be interpreted as "return" in the traditional sense. Regardless, they represent one interpretation of returns. We present these results in table 5 below.

Table 5: *Retail & Manufacturing R-BCR Estimates*

	Short Run	Long Run
Retail	38.8850	48.5901
Manufacturing	165.7080	179.0087

Note: Estimates generated by using the counterfactual method in Ward (2013, 2018).

Clearly, these estimates are highly favorable and suggest that an additional dollar of marketing investment in the manufacturing channel, for example, may generate an additional $165.71 of revenue in the short run and $179.01 in the long run. These estimates are very large due to the fact that demand is inelastic - any small shift in demand is likely to generate very large changes in revenue, even though that revenue may not be profitable from a stakeholder perspective.

In summary, we find that all NHB marketing activities are profitable regardless of the time frame of the analysis. Because we estimate return on investment in terms of the profit expected on the last dollar spent, our results suggest that honey production and marketing would be significantly more profitable if more dollars were allocated to NHB activities in general, and in the manufacturing channel specifically. That is, we estimate each model accounting for the diminishing marginal returns to marketing investments, so if budgets become too large, then the estimates would become smaller with size. We find no evidence of this effect at current budget levels.

Conclusions and Recommendations

Per capita honey demand rose over the 2018 - 2022 study period, in spite of a rapid rise in prices. This summary observation suggests that there were intervening factors in the honey market that led to a rise in honey demand, regardless of higher prices. This study uses data from 2018 - 2022 to investigate the return on investment for producer and importer

[5] Our approach in generating these values follows Ward (2013, 2018) exactly. That is, we estimate the predicted pounds and value of honey production with NHB investments, and then reduce NHB investments by 50% and calculate the new implied values of pounds and value. The change in value is the additional revenue attributed to a hypothetical 50% change in NHB activities.

dollars invested in all NHB marketing activities, aggregated into a single measure of NHB impact on honey demand. Because many factors other than marketing activities can explain changes in demand over time, the specific role of the NHB in helping maintain consumer demand is an important, and empirical question.

We find that NHB activities were effective in raising demand when controlling for the effect of prices, yearly effects, changes in production conditions, increasing income and other factors relevant to the demand for retail and manufacturing honey. In general, we find that all marketing activities were profitable in both the retail and manufacturing markets, in both the short and the long-run.

In arriving at these conclusions, we recognize that the quality of our findings are inevitably limited by the quality of the data. While the ERS-USDA data describing retail and manufacturing sales of honey are widely regarded as accurate and useful for this purpose, modern quantitative marketing evaluations typically use data at a higher frequency (i.e., monthly or weekly) and a a greater level of granularity (i.e., product or package types) that reflect the differentiated nature of all consumer products. Matching high frequency demand data to equally granular marketing data, on more precisely defined sets of activities, would likely generate insights of greater value to management than those provided here. Future evaluations of this type would benefit greatly from direct measures of consumption – and prices – for honey sold into both the retail and ingredient channels. This recommendation is particularly relevant given the importance of the manufacturing market both in terms of the overall dollar sales level and "at the margin," or the changes in shipments from month to month that have a magnified effect on prices.

Appendices

Appendix 1. Retail Demand Model

This appendix describes in more detail the specific econometric models that are used in estimating the impact of NHB marketing activities on the demand for honey in the domestic retail and manufacturing markets. For this analysis, it is assumed that the market segments are independent so we estimate separate models for each.

In this appendix, we use the retail market model (estimated using ERS-USDA data) as an example. Implicitly, by using this model we assume retail honey is differentiated from all other consumer products so their demands can be considered independent. As such, an individual consumer is assumed to allocate his or her income in a way that means that the demand for honey is a function of the price of honey, a measure of income, and other "shift" variables that are likely to explain individual-level honey demand. We begin by defining a random utility representation of individual household demand, and then aggregate over the distribution of consumer heterogeneity to arrive at a consistent aggregate demand for honey in the market as a whole.

We write the utility for household h as:

$$u_{hj} = v_{hj} + \epsilon_{hj} = \beta_{0j} + \sum_k \beta_{1k} x_{jk} + \sum_l \gamma_l f(A_1) - \alpha p_j + \xi_j + \epsilon_{hj}.$$

where β_{0j} is the maximum willingness to pay for honey of type or variety j, p_j is the retail price of product j, x_j is a set of other explanatory variables, including personal income, a time trend or qualitative indicators to account for other non-quantifiable factors that may affect honey sales, $f(A_1)$ is the stock of marketing capital created by investments in marketing activity l by the MC, ξ_j is an unobservable (to the econometrician) error term and ϵ_{hj} is a random error, assumed to be iid extreme value distributed. Household h will choose the product of type j if the utility from this choice is greater than the utility from all other alternatives. In other words, the probability that household h chooses j over all others is governed by the distribution of ϵ_{hj} because:

$$\begin{aligned} Pr(j = 1) &= Pr(v_{hj} + \epsilon_{hj} > v_{hi} + \epsilon_{hi}) \\ &= Pr(v_{hj} - v_{hi} + \epsilon_{hj} > \epsilon_{hi}). \end{aligned}$$

As is well understood, if ϵ_{hj} is distributed extreme value, the random utility model in this equation implies share functions for each product of type $j = 1, 2, ..., J$ of:

$$S_j = \frac{\exp(v_{hj})}{1 + \sum_{i=1}^{I} \exp(v_{hi})}$$

where S_j is the market share of product type j. This expression yields the multinomial logit (MNL) model of discrete choice used by Berry (1994), Nevo (2001) and many others to study the structure of demand for differentiated products. Although the simple MNL model in this equation suffers from the proportionate draw problem (also called the "independence of irrelevant alternatives, or IIA problem), meaning that the cross-elasticities for all alternatives are equal, the IIA problem is of little consequence in this application. Promotion effectiveness depends on the own-price and marketing-elasticity and, to a much lesser extent, on the cross-price elasticity. Consequently, the degree of error caused by the IIA simplification is likely to be very low.

Our primary interest in estimating these equations lies in obtaining price and marketing elasticities. Elasticities are derived from the MNL model by finding the derivative of the share function in price (marketing) and multiplying by the ratio of price (marketing capital) to the mean share. The resulting expressions are given by:

$$\epsilon_{p_j} = (\partial S_j/\partial p_j)(p_j/S_j) = \alpha\bar{p_j}(1 - \bar{S_j}),$$

in price, and:

$$\epsilon_{A_{jl}} = (\partial S_j/\partial A_l)(\bar{A_l}/\bar{S_j}) = \gamma_l\bar{A_l}(1 - \bar{S_j})$$

in marketing capital. Evaluating each elasticity specific to each product type provides valuable information on the differential effect of price changes and marketing investments on sales of honey relative to the "outside option" or everything else that honey-purchasing households may allocate income to. These response parameters form the key input to the profit calculation model described below.

Appendix 2. Returns Calculation

This appendix describes the way in which we will calculate the increment to stakeholder profit given the impact parameters estimated according to the procedure described above. This model is similar to one used in Richards and Patterson (2000) and was originally developed by Kinnucan et al. (2000). To calculate profit, the analysis takes into account: (1) the activity impact on demand quantity (retail or manufacturing), (2) the impact on price, (3) the feedback effect of higher prices on market supply, and (4) the transmission of retail prices to the producer level. Although the final solution consists of a single equation, the model requires separate components for each element (1) to (4). Again in mathematical terms, this model, written in terms of the change in the log of each variable value, appears as:

$$\begin{aligned} d\ln\mathbf{Q_r} &= \mathbf{N_r}d\ln\mathbf{P} + \mathbf{G}d\ln\mathbf{Z_r} + \sum\mathbf{B_j}d\ln\mathbf{A_j} \\ d\ln\mathbf{X} &= \mathbf{E_s}d\ln\mathbf{W} \\ d\ln\mathbf{W} &= \mathbf{T}d\ln\mathbf{P} \\ w_r d\ln\mathbf{Q_r} &= d\ln\mathbf{X}, \end{aligned}$$

where the first equation represents the effect of marketing investments on demand, the second is the effect on output supply, the third measures the rate of price-transmission from retail to the farm-gate, and the fourth is the market equilibrium identity. Each equation is then substituted into market equilibrium to solve for the resulting price impact of the marketing program:

$$d\ln\mathbf{P} = \mathbf{M}^{-1}\mathbf{G}d\ln\mathbf{Z_r} + \sum\mathbf{M}^{-1}\mathbf{B_j}d\ln\mathbf{A_j},$$

Given this change in prices, the addition to profit is then calculated as:

$$d\pi = \sum_i S_i^f P_i Q_i d\ln W_i(1 + 0.5d\ln X_i),$$

where the subscript indicating activity l has been suppressed for clarity. Each of the variables and parameter values are defined as follows: $\mathbf{W}$ = variables representing FOB (producer or importer) prices for each product, $\mathbf{X}$ = variables representing supplies of each product, $\mathbf{P}$ = variables representing market prices, $\mathbf{Q_r}$ = variables representing retail and manufacturing quantities, w_r = share of market in retail or manufacturing, S_{if} = grower's share of the retail dollar for the i^{th} product type, $\mathbf{Z_r}$ and $\mathbf{Z_x}$ = factors affecting demand in retail and manufacturing markets, $\mathbf{A_j}$ = variable representing marketing activity j, $\mathbf{N_r}$ and $\mathbf{N_x}$ = groups of retail and import demand price-response terms, $\mathbf{B_j}$ = response measures for the k^{th} type of activity, $\mathbf{T}$ = price-transmission elasticities (percent of price going to the producer), $\mathbf{G}$ = demand elasticities with respect to exogenous retail factors, E_s = supply response elasticities, $\mathbf{M}$ = $\mathbf{E_s}\mathbf{T} - w_r\mathbf{N_r}$ = solution for the change in price variable.

While values for most of these variables are estimated in the relevant demand model, the supply-response elasticities, price-transmission elasticities and growers' share of the retail dollar are not. First, reliable estimates of the elasticity of supply are difficult to come by and are not estimable with the data at hand. Therefore, we calculate the return to each marketing activity under a range of supply elasticities from 0.25 to 1.5. Based on previous research for other commodities, however, it is determined that a supply elasticity of 1.0 in the long run is the most likely. This means that a 10 percent increase in the producer price is likely to lead to a long run increase in the supply of honey of 10 percent. Second, the price-transmission elasticity is calculated using the formula in Gardner (1975) as:

$$\mathbf{T} = \frac{\mathbf{E_b}}{S_f \mathbf{E_b} + (1 - S_f)\mathbf{E_s}},$$

where E_b is the elasticity of supply of non-farm inputs, which is assumed to equal 1.5. Third, ERS-USDA reports the farm share of the retail dollar for all specialty crops and products as 0.255, so we adopt this value as an approximation to the share earned by honey producers.

This model, while appearing quite complicated, is easily implemented with any spread sheet or data base software. Based on the incremental profit calculated in the model above, the net present value of investment in activity l is calculated as:

$$NPV_l = \sum_{t=1}^{40} \exp(-rt) d\pi_l - c_l,$$

where $\exp(-rt)$ is the "present value factor" that is used to calculate the present value of incremental operating in month t at time 0 at a discount rate r, c_l is the amount of expenditure on activity l and summing over a forty month period reflects the assumed long-range planning horizon of the NHB. If NPV_l is greater than zero at an interest rate that reflects NHB members' opportunity cost of capital, then investments in activity l are economically viable.

Appendix 3. Detailed Model Estimates

In this appendix, we present Table 6, which shows the detailed parameter estimates for the retail and manufacturing demand models, along with the associated t-statistics. As explained in the text, all of the parameter estimates are indeed significantly different from zero.

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Table 6: *Demand Model Estimates: Retail and Manufacturing*

	Retail			Manufacturing	
Variable	Estimate	t-ratio	Variable	Estimate	t-ratio
Constant	11.125	83.342	Constant	12.581	11.872
Lagged Volume	0.229	36.643	Lagged Volume	0.171	26.021
Log(Income)	-0.068	-2.349	Log(P. Con.)	-0.092	-5.943
Trend	0.035	30.365	Log(P. Bee)	0.139	18.568
Control Function	0.0490	51.392	Trend	0.029	130.022
Log(Price)	-0.282	-70.5.98	Control Function	0.279	69.887
Log(NHB)	0.059	223.141	Log(Price)	-0.101	-63.398
			Log(NHB)	0.089	55.037
R^2	0.460		R^2	0.945	